ELEC 261 Electronic Materials and Devices

Guru Naik
Fall 2019
1:00PM-1:50PM MWF RYN 201

Contact Information

Instructor: Guru Naik
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Office Hours: TBD

Course Objectives

The primary objective of the course is to introduce the physics behind the operation of electronic and optoelectronic devices that have revolutionized our society. Starting from quantum mechanics, the course will discuss the microscopic origin of the electronic and optical properties of materials and elucidate the operation of basic devices such as diodes, transistors, LEDs and solar cells.

Course Learning Outcomes

Students completing the course will be able to:
(1) discuss and apply fundamental concepts and theories of solid state physics focusing on the atomic-scale physics behind the transport of electricity in materials
(2) identify, formulate, and solve scientific and engineering problems related to the electronic and optoelectronic properties of solids
(3) describe commercial processor and memory technology based on silicon and the physics behind ongoing research on possible alternatives and novel materials
(4) apply techniques, skills, and modern engineering tools necessary for practices in the field of solid state science and engineering

Required Texts and Materials

- James D. Livingston, Electronic Properties of Engineering Materials (Wiley, 1999)
- Streetman & Banerjee, Solid State Electronic Devices, 7th. Edition. (Pearson 2014).

Exams and Papers

45% - 3 in-class quizzes

25% - Take home final exam

30% - Homework

Grade Policies

Students are allowed to work in groups on the homework unless otherwise mentioned. On the homeworks, it is very important to SHOW YOUR WORK. Homework assignments will be accepted late with a penalty of 10% per class period after they are due.

Quizzes will be in-class, closed-book but with one page of notes allowed. Quizzes and exam MUST be an individual effort and any violations of this will be considered violations of the Rice Honor Code.

The final grade may be curved to fit the class in 6-sigma. The default threshold scores for the various final grades are: 90% for some flavor of A: 80% for some flavor of B; 70% for some flavor of C, etc. These thresholds may be lowered, but will not be raised.

Rice Honor Code

In this course, all students will be held to the standards of the Rice Honor Code, a code that you pledged to honor when you matriculated at this institution. If you are unfamiliar with the details of this code and how it is administered, you should consult the Honor System Handbook at http://honor.rice.edu/honor-system-handbook/. This handbook outlines the University's expectations for the integrity of your academic work, the procedures for resolving alleged violations of those expectations, and the rights and responsibilities of students and faculty members throughout the process.

Absence Policy

Students are expected to be physically present during the quiz sessions. Only if the circumstances do not allow, will an exception be made by the instructor.

Disability Resource Center

If you have a documented disability or other condition that may affect academic performance you should: 1) make sure this documentation is on file with the Disability Resource Center (Allen Center, Room 111 / adarice@rice.edu / x5841) to determine the accommodations you need; and 2) talk with me to discuss your accommodation needs.

Syllabus Change Policy

The information contained in the course syllabus, other than the absence policies, may be subject to change with reasonable advance notice, as deemed appropriate by the instructor.

Course Schedule

Week-1: Bonding and crystal structure
Week-2: Drude model and metals
Week-3: Hall effect and AC conductivity
Week-4: Quantum Mechanics
Week-5: Energy levels
Week-6: Atoms and molecules
Week-7: Periodic potential
Week-8: Band structure
Week-9: Semiconductors
Week-10: Fermi level
Week-11: Drift, diffusion, diode
Week-12: LEDs, Photodetectors and Solar cells
Week-13: Switches and IC technology
Week-14: Beyond CMOS: Superconductors and quantum information, Spintronics, Nanophotonics